Material's Perspective on Designing Collector for Sn Based EUV Sources

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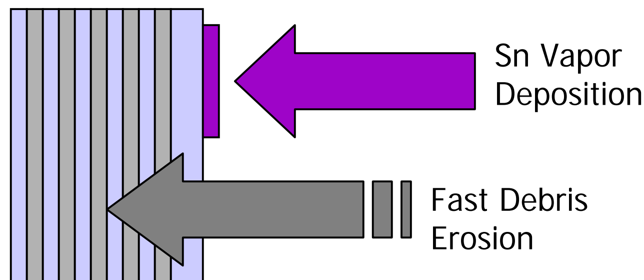
Sn Collector Optic Lifetime Issues

Fast Debris Sputter Erosion

- In Japan, source suppliers quoted collector lifetime of 10B shots for grazing-incidence.
- For a 10 kHz system, this corresponds to a lifetime of about one month.
- Near-term improvements in fast ion debris mitigation should increase this to about 3 months.
- The fast ion erosion is still a major problem for MLM optics.



Sn Vapor Condensation

- Mass-limited Sn injection still leads to significant vapor deposition on the optic surface.
- Reactive ion etching of Sn off collector materials has been demonstrated.
- Etch selectivity approaching 10,000:1 have been observed for SiO_2 capping layers with Cl_2 recipes.
- If plasma density and mirror bias voltages can be accurately controlled, a 5nm SiO_2 capping layer will be etched in about 1 month for a Sn deposition rate of 1nm/min on the HVM optic.
- However, the etch stop will eventually be removed.

Erosion-Deposition For DPP vs. LPP

LPP Fast Debris Emission

- Recent results in LPP are showing promise for low energy ion emission and pre-pulse shaping could lead to lower total erosive ion yields.
- Several researcher reported observing high energy DPP ions. This is a problem since the pulse power unit and z-pinch geometries are harder to optimize easily.
- LPP does have the advantage of flexibility with optimization. Perhaps encouraging data will be presented here today.
- If debris mitigation combined with laser optimization could decrease the fast debris flux, what about condensable Sn vapor?

Renewable Etch Stop Trick ?

- What if a periodic oxygen discharge could reform an SiO_2 etch stop on the surface of a normal incidence MLM mirrors.
- Large bilayer stacks could then have lifetime extension for RIE etch selectivity.
- This process could extend the RIE rate limiting step to greater than 1 year.
- The fast ion erosion problem would still need to be tackled.
- There are many problems to be overcome with etch uniformity, especially with multi-shell grazing incidence optics.